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SUBJECT: REVIEW FOR CYPERMETHRIN WATER QUALITY CRITERIA DERIVATION

The cypermethrin water quality criteria were derived by applying a methodology recently developed by the University of California, Davis (TenBrook et al. 2009). The authors evaluated 108 original studies on the effects of cypermethrin on aquatic organisms and identified 8 acute and 2 chronic toxicity studies that were reliable and relevant for the water quality criteria derivation.

The acute water quality criterion was derived by using the species sensitivity distribution (SSD) procedure since data sets from more than five taxa were sufficient to conduct the procedure. A couple of adjustments were made according to the methodology due to the nature of the data sets. The log-logistic distribution was selected for the SSD procedure instead of the Burr III distribution due to the latter's lack of fit to the data sets. The median 1st percentile value was used for the final criterion calculation instead of the median 5th percentile value because the criterion calculated from the 5th percentile value was two times higher than the SMAV of the most sensitive species *Hyalella azteca*. The selection of a better distribution and the adjustment for the final criterion calculation appear to be necessary and appropriate. The adjusted SSD procedure resulted in a final acute water quality criterion of 1 ng/L. The report properly evaluated the existing toxicity data from sensitive, threatened, and endangered species and ecosystem studies. The evaluation suggested that the derived acute criterion is protective of aquatic organisms under the current knowledge of cypermethrin toxicity.

The chronic water quality criterion was calculated by using the acute-to-chronic ratio (ACR) method. For the same reasons discussed previously for acute criterion derivation, the median 1st percentile value from the log-logistic distribution of acute toxicity values was used to calculate the chronic criterion. However, the use of the ACR calculated from a *Daphnia magna* toxicity study (Kim et al. 2008) is arguable for the following reasons:

1. The report stated that "it is recommended that only the SMACRs for species with SMAVs within a factor of 10 of the acute 5th percentile value should be used for the final multi-species ACR (section 3-4.2.1, parts 1-2 TenBrook et al. 2009a), which for

cypermethrin is only the SMACR for *Daphnia magna* of 949" (Page 7-8). The statement is inaccurate because the *Daphnia* SMAV is over a factor of 20 of the acute 5th percentile value (0.01269 µg/L/0.0006 µg/L SMAV = 21).

2. From my understanding, the cypermethrin chronic toxicity data sets do not meet any of the three conditions for the ACR calculation recommended on Section **3-4.2.1 Single-chemical, multispecies ACR based on measured data**, **TenBrook et al. 2009**. As described in the report, the SMACRs of the three species rated as RR for the chronic criterion derivation did not show a clear trend of increasing or decreasing as the SMAVs increased, the ACRs from all the species are not within a factor of ten, and none of the SMACRs are less than 2.0. Therefore, as recommended by TenBrook et al., the ACR should be derived by the procedure in Section 3-4.2.2, i.e., calculating the geometric mean of any available ACRs based on **measured** data, plus enough default ACRs of 12.4. In the case of cypermethrin, the ACR would be 3.9 that was used in the report as an example chronic criterion.

3. The acute toxicity value by Kim et al. (2008) was rated as having low reliability and excluded from the acute criterion derivation. Therefore, using the acute data to calculate the ACR that is used for the chronic criterion calculation is inconsistent with the acute criterion calculation even though the data is the lowest and provides the most protective criterion.

4. As reasoned in the report, toxicity values calculated with measured concentrations are typically lower than those calculated with nominal concentrations because pyrethroids tend to adsorb to glassware and solids resulting in less bioavailability in the dissolved phase (Page 8, this report). Therefore, the water quality criteria derived from toxicity of nominal concentrations tend to be less protective of aquatic life. The rational is likely true for acute and chronic toxicity calculations but not necessarily true for ACR calculations. It is unknown whether the adsorption is proportional to chemical concentrations and exposure durations or whether a linear relationship between the adsorption and concentrations exists. Using nominal concentrations to calculate ACR values can add another tier of uncertainty to the final criterion calculation.

The authors appropriately addressed the limitations and uncertainties involved in the criteria derivation. Because of the high hydrophobicity of pyrethroids that could lead to significant chemical loss in dissolved phase during toxicity tests, it is more appropriate to derive the criteria by using measured concentrations from flow-through tests. However, the majority of the toxicity data used for the criteria derivation are from static or static renewal tests and are calculated from nominal concentrations. This could underestimate the toxicity of cypermethrin resulting in an underestimated water quality criterion. For the chronic criterion, the limitations and uncertainties are primarily attributed to the limited number of data sets (only three reliable and relevant data

sets available), the lack of paired data to calculate a multi-species ACR, and the absence of the chronic toxicity data on the most sensitive species *Hyalella azteca*. Other uncertainties are related to toxicity increases with lower temperatures and addition of PBO in pyrethroid formulations. Nevertheless, those limitations and uncertainties could not be corrected or quantified unless additional data are available in the future.

Editorial comment: spell out "SR" on the 2nd paragraph, page 12. "SR" stands for "Static renewal test" in this report but it is not the case here.

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